Nuclear Isomers:
Syntheses, Production, Utilization of Ultra-High Energetic Materials

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Abstract:
Nuclear isomers constitute an ultra-high energetic material. Their energy content amounts to 10^{12} J/kg, whereas chemical substances deliver 10^4 to 10^5 times less energy. Physics (shape isomers, spin-traps, K-traps), quantum nucleonics, nuclear chemistry and atomic-nuclear interaction of nuclear isomers are described. Several technologies for the production, analysis, utilization and controlled discharge of nuclear isomers are presented with detailed calculations and experimental designs.

Production Technologies:

- Neutron activation in high-neutron flux nuclear reactor
- Neutron activation by neutron generator (pyroelectric crystal neutron generator)
- High-energy laser activation (10^{21} W/cm^2; strong-field physics and chemistry)
- High-strength magnetic fields (for deformation of nuclei)
- Magnetic compression of material to achieve nucleosynthesis conditions
- Chemically induced magnetic compression (Z-pinch)

Separation Methods for obtaining pure nuclear isomers:

- Chemical Separation of Isomers
- Plasma separation with electromagnetic fields and separation of resonance ions (Calutrons)
- Laser separation by selectively stripping electrons
- Laser separation by atomic-nuclear environment modification
- Gravito-magnetic separation technique exploits different effects of normal & deformed nuclei
- Interaction of Electromagnetic field with deformed nuclei (different from normal nuclei)

Energy Storage and Controlled Release:

- Laser induction with ultra-high energy photons
- Electro-Magnetic Induction by ultra-strong EM fields
- Induction by atomic-nuclear environment modification
- Plasma Induction by energy injection into the plasma with resonance RF (radio frequency) heating (with high power solid-state microwave devices) induces at resonance frequency discharge of nuclear isomers.

Applications:

- Energy storage (nuclear isomer battery)
- Advanced propulsion
- Explosive devices
- Gamma-ray laser
- Probing nuclear structure
- Nucleosynthesis

75 references
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